“A Brief Biography of Vinton Cerf”

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Contemporary society has yielded several men and women whose contributions to technology have been profound. Those responsible for the interconnection of humanity via telecommunications technology perhaps transcend even this elite group. Electronic communications, and its most popular manifestation, the Internet, have changed our perception of knowledge, society and the way human beings interact. For any technology there always exists a pioneer, an individual who could perceive the world as it could be. For the Internet, that person is Vint Cerf.

Before one can accurately explain the way Vint Cerf fits in to the history of the Internet, one must be understand a little about the history of the network its self. Packet switching technology, which was first theorized by Leonard Kleinrock of MIT in 1961, is the core technology that makes the seamless interconnection of geographically disperse computing systems possible. [i]Kleinrock was convinced that creating a link between two systems without the presences of a physical circuit was possible. To accomplish this, he proposed a system that would side step the limitations of the circuit switched telephone network of the time by creating a "connectionless" or packet-switched network. Another MIT researcher, Lawrence G. Roberts, would take the idea for the packet switched network to the Defense Advanced Research Projects Agency (DARPA.)[ii] Roberts proposal for the DARAPANET consisted of an entirely packet-switched network that would allow for the then incredible line speed of 50 kbps. Roberts and others from his team secured funding for ARPANET in 1968,

and quickly had four interconnected machines communicating across the network.[iii]

The original network, though successful, faced reliability and addressing issues because of its dependence on the Network Computing Protocol, a first revision packet-switching system that couldn't address as many hosts as the researches would like to add to their system. It is here where Cerf added his genius to the conception of the Internet. Vinton Gray Cerf grew up in San Francisco, the son of a Navy officer who fought in World War II[iv]. He would receive a B.S. in mathematics from Stanford, and graduate degrees from UCLA. However, it was his research work at Stanford that would begin his lifelong involvement in the Internet.

Vint Cerf, then a researcher at Stanford, had been involved in the design of the protocol, but was aware of its limitations and the need for a more robust language for the computers on the network to speak. In 1973, Cerf and another Internet pioneer, Bob Kahn, began work on the Transmission Control Protocol/Internet Protocol.[v] Kahn envisioned the protocol to introduce many concepts that would become the basis for data transmission and interchange over the network. These included the concept of "gateways" that would direct and route packets to their destination, comprehensive error correction systems, and the long sought-after global addressing. With out this protocol, which really is the technical conceptualization of the Internet, we would not have the data driven society that exists today. In September of 1973, at Sussex University in the UK, Cerf and Kahn convened the first working group to discuss the protocol. At the

conference, the protocol took shape even further. It came to incorporate such separate features as TCP as well as UDP, the user datagram protocol. UDP was available to users who didn't want the error correction and transmission control features of TCP, but only direct access to the network. Both of these features are still in use today. The first demonstration of the Internet as we know it today took place in July 1977. This was the first time a global WAN, or wide area network, was in operation. This was made possible almost entirely by Cerf and Kahn's packet switching technologies. Cerf gives a description of the network in his paper "How the Internet Came to Be":

> The earliest demonstration of the triple network Internet was in July 1977. We had several people involved. In order to link a mobile packet radio in the Bay Area, Jim Mathis was driving a van on the San Francisco Bayshore Freeway with a packet radio system running on an LSI-11. This was connected to a gateway developed by .i.Internet: history of: Strazisar, Virginia; Virginia Strazisar at BBN. Ginny was monitoring the gateway and had artificially adjusted the routing in the system. It went over the Atlantic via a point-to-point satellite link to Norway and down to London, by land line, and then back through the Atlantic Packet Satellite network (SATNET) through a Single Channel Per Carrier (SCPC) system, which had ground stations in Etam, West Virginia, Goonhilly Downs England, and Tanum, Sweden. The German and Italian sites of SATNET hadn't been hooked in yet. Ginny was responsible for gateways from packet radio to ARPANET, and from ARPANET to SATNET. Traffic passed from the mobile unit on the Packet Radio network across the ARPANET over an internal point-to-point satellite link to University College London, and then back through the SATNET into the ARPANET again, and then across the ARPANET to the USC Information Sciences Institute to one of their DEC KA-10 (ISIC) machines. So what we were simulating was someone in a mobile battlefield environment going across a continental network, then across an intercontinental satellite network, and then back into a wireline network to a major computing resource in national headquarters. Since the Defense Department was paying for this, we were looking for demonstrations that would translate to militarily interesting scenarios. So the packets were traveling 94,000 miles round trip, as opposed to what would have been an 800-mile round trip directly on the ARPANET. We didn't lose a bit! [vi]

Cerf's technical contributions here would translate into societal contributions in the coming 30 years. Without a robust, service-oriented approach to the Internet, society may have had to wait another decade for modern information technology to arise. Because Cerf and Kahn's vision for TCP/IP allowed a high degree of flexibility and interoperability, it would allow the Internet and associated services like the World Wide Web and the current wireless revolution to flourish. An article in Washingtonian magazine described Cerf and Kahn's influence on the gigantic tidal wave that is the Internet:

> "Take away Bill Gates, and the computer and networking revolution would be largely unchanged, if not improved. Gates rides the wave and banks the profits. But Cerf and Kahn, more than anyone else, created the wave. Without them, and the guiding philosophy of other '60s grad students, life in this free-wheeling Information Age would be very different."[vii]

Cerf's contributions to the success of the Internet are more then merely technical. Because he was able to realize the possibilities and opportunities that the marriage of telecommunications and information technology would bring, he began in the late 1970s to form several professional organizations that would further shape the part of the Internet. These organizations included the International Cooperation Board, the Internet Research Group and the Internet Configuration Control Board (ICCB.) The ICCB would go through several iterations, finally becoming in 1985 the Internet Engineering Task Force (IETF.) IETF would go on to have a decisive impact on the technical and conceptual definition of the Internet. Through its Request For Comments (RFCs) the IETF lays down the technical underpinnings of the Internet. RFCs define such services as HTTP, FTP and DNS, all critical to the way the Internet operates and the high

degree of convienence at which it can be used. The first RFC was published by Steve Crocker at UCLA in April of 1969. Since Cerf and the other members of the team working on developing the protocols and other technical legwork for the network were mostly graduate students, the RFC was so named as not to be imposing on other researchers and comments. Crcoker believed that “we were just graduate students at the time and so had no authority.” According to Cerf, RFC was chosen as the name because it conveys more of a “"Please comment on this, and tell us what you think," feel then simply imposing a new protocol as law.

As important as his contributions to the birth of TCP/IP were Cerf’s vision for an interconnected, globally addressable electronic mail system. E-mail, the proverbial killer app of the 1990s, showed even the most casual computer user the inherent value to connecting his or her PC to the global network, and would spawn a massive commercial industry devoted to E-mail services and software. Although the technical ability for this had existed since the standardization of most commercial and government networks on TCP/IP, few so the need for this ability or realized the commercial application that was to come. Even Cerf himself questioned the feasibility of an interconnected global messaging system from a policy standpoint; since many of the networks that would become part of the e-mail system would be government or militarily run, he was unsure that they would be willing or allowed to partake in his system. Nonetheless, in 1988 he finalized his decision to try to create the system:

> In 1988 I made a conscious decision to pursue connection of the Internet to commercial electronic mail carriers. It wasn't clear that this would be acceptable from the standpoint of federal policy, but I thought that it was important to begin exploring the question. By 1990, an experimental mail

> relay was running at the Corporation for National Research Initiatives (CNRI) linking MCI Mail with the Internet. In the intervening two years, most commercial email carriers in the U.S. are linked to Internet and many others around the world are following suit. [viii]

Cerf, describing his project in 1993, still had no idea what kind of a movement he had started. The 90s showed that once the technical ability and infrastructure to handle the messaging system was in place, people would make use of the system to its fullest extent. Not only large commercial and academic users have realized the productivity and efficiency gains presented by e-mail, but individuals have realized the heightened degree of connectedness they can achieve with their family and friends through use of the medium.

Cerf also realized the need to make IP the most prevalent protocol, interoperable over any physical network layer. He termed this effort “IP over everything,” and would go on to make sure that the protocol which he co-designed would run on all most all computing platforms and network vendor hardware.

> One of the main goals of the project was "IP on everything." Whether it is frame relay, ATM, or ISDN, it should always be possible to bring an Internet Protocol up on top of it. We've always been able to get IP to run, so the Internet has satisfied my design criteria. But I didn't have a clue that we would end up with anything like the scale of what we have now, let alone the scale that it's likely to reach by the end of the decade.[ix]

Cerf granted his design flexibility, a flexibility that would make such interoperability possible. Because of this, IP would not be surpassed by another packet-switching data protocol but instead go on to become the way the world interconnects its computing platforms. This, as well as his philosophical and visionary contributions to the

course the Internet has taken, makes his contributions to the information society invaluable.

[i] Cerf, Vinton G.et al.(2000). All About the Internet: A Brief History of the Internet. Internet Society . Recived March 22, 2001 from the World Wide Web: http://www.isoc.org/internet/history/brief.html

[ii] Cerf, Vinton G.et al.(2000). All About the Internet: A Brief History of the Internet. Internet Society . Recived March 22, 2001 from the World Wide Web: http://www.isoc.org/internet/history/brief.html

[iii] Cerf, Vinton G.et al.(2000). All About the Internet: A Brief History of the Internet. Internet Society . Recived March 22, 2001 from the World Wide Web: http://www.isoc.org/internet/history/brief.html

[iv] Vint Cerf – Network Bio. (2000) The Industry Stanard. Retrived March 22, 2001 from the World Wide Web: http://www.thestandard.com/people/display/0,1157,1081,00.html

[v] Cerf, Vinton G.et al.(2000). All About the Internet: A Brief History of the Internet. Internet Society . Recived March 22, 2001 from the World Wide Web: http://www.isoc.org/internet/history/brief.html

[vi] Cerf, Vincent. (1993) How the Internet Came To Be. Bell-Labs.com Recived March 22, 2001 from the World Wide Web: http://www.bell-labs.com/user/zhwang/vcerf.html

[vii] Cerf, Vincent. (1993) How the Internet Came To Be. Bell-Labs.com Recived March 22, 2001 from the World Wide Web: http://www.bell-labs.com/user/zhwang/vcerf.html

[viii] Cerf, Vincent. (1993) How the Internet Came To Be. Bell-Labs.com Recived March 22, 2001 from the World Wide Web: http://www.bell-labs.com/user/zhwang/vcerf.html

[ix] Cerf, Vincent. (1993) How the Internet Came To Be. Bell-Labs.com Recived March 22, 2001 from the World Wide Web: http://www.bell-labs.com/user/zhwang/vcerf.html